

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A method for qualifying a reflective optical element having a free interface at which radiation is reflected, the method comprising:

measuring at various wavelengths and/or various incidence angles of the radiation a reflectance and a photoelectron current induced by the radiation in an area of the free interface resulting in: (a) a reflectance curve as a function of wavelength and/or incidence angle wherein the reflectance curve has a wavelength region of maximum reflectance and/or an incidence angle region of maximum reflectance; and (b) a photoelectron current curve as a function of wavelength and/or incidence angle wherein the photoelectron current curve has a profile within the wavelength region of maximum reflectance and/or the incidence angle region of maximum reflectance; and

using the profile of the photoelectron curve for determining a phase shift of a standing electromagnetic wave of incident radiation with respect to the free interface, or using the profile of the photoelectron curve for determining an intensity a standing electromagnetic wave of incident radiation with respect to the free interface wherein the photoelectron current curve and the reflectance curve are measured at several points on the interface in order to achieve spatial resolution.

2-70. (Canceled).

71. (Previously Presented) The method of claim 1, wherein the method includes using the profile of the photoelectron curve to determine a phase shift of a standing electromagnetic wave of incident radiation with respect to the free interface.

72. (Previously Presented) The method of claim 1, wherein the method includes using the profile of the photoelectron curve to determine an intensity of a standing electromagnetic wave of incident radiation with respect to the free interface.

73. (Previously Presented) The method of claim 1, further comprising determining the slope of the profile of the photoelectron current curve at the wavelength of maximum reflectance and/or the incidence angle of maximum reflectance.

74. (Previously Presented) The method of claim 1, further comprising determining a maximum or minimum of the profile of the photoelectron current curve within the wavelength region of maximum reflectance and/or the incidence angle region of maximum reflectance, wherein the wavelength corresponding to the maximum or minimum of the profile of the photoelectron current curve is closest to the wavelength corresponding to the maximum of the reflectance curve.

75. (Previously Presented) The method of claim 1, wherein the radiation is EUV radiation.

76. (Previously Presented) The method of claim 1, wherein the wavelength region of maximum reflectance or the incidence angle region of maximum reflectance is from -3% to 1% of the wavelength of maximum reflectance or the incidence angle of maximum reflectance.

77. (Cancelled)

78. (Currently Amended) A method for qualifying a reflective optical element that includes a multilayer system having a free interface at which radiation is reflected and/or a cap layer system and having a free interface at which radiation is reflected, the method comprising:

(i) measuring at various wavelengths and/or incidence angles of the radiation a reflectance and a photoelectron current induced by the radiation in an area of the free interface resulting in: (a) a first reflectance curve as a function of wavelength and/or incidence angle wherein the first reflectance curve has a wavelength region of maximum reflectance and/or an incidence angle region of maximum reflectance; and (b) a first photoelectron current curve as a function of wavelength and/or incidence angle wherein the first photoelectron current curve has a first profile within the wavelength region of maximum reflectance and/or the incidence angle region of maximum reflectance;

(ii) comparing the first reflectance curve and/or the first profile with a second reflectance curve and/or a second photoelectron current curve, wherein the second reflectance curve and/or the second photoelectron current curve is obtained by a simulation for a given thickness of the layers of the multilayer system and/or a given thickness of the layers of the cap layer system, the second photoelectron current curve having a second profile; and

(iii) if the first reflectance curve and/or the first profile do not approximately coincide with the second reflectance curve and/or the second profile, repeating (ii) with a different thickness of the layers of the multilayer system and/or a different thickness of the layers of the cap layer system,

wherein:

the method determines a thickness profile of the multilayer system and/or the cap layer system of the optical element; and

the photoelectron current curve and the reflectance curve are measured at several points on the interface in order to achieve spatial resolution.

79. (Previously Presented) The method of claim 78, wherein the radiation is EUV radiation.

80. (Previously Presented) The method of claim 78, wherein in (ii) the first profile and/or the first reflectance curve are compared with reference data measured at a reflective

optical element with a multilayer system and a cap layer system of known thickness instead of comparing with a second reflectance curve and/or a second photoelectron curve obtained by simulation.

81. (Cancelled)

82. (Withdrawn) An apparatus, comprising:  
at least one photoelectron detector and at least one tuneable monochromator, wherein the apparatus is a EUV lithography apparatus.

83. (Withdrawn) The apparatus of claim 82, wherein a wavelength used in the apparatus can be switched between a first wavelength and a second wavelength, the first wavelength being the wavelength at which the apparatus is operated during exposure, and the second wavelength being the wavelength at which the apparatus is used to qualify optical elements arranged in the apparatus.

84. (Withdrawn) The apparatus of claim 83, wherein the tuneable monochromator comprises:

a first reflective optical element, comprising:

a first multilayer system with a maximum of reflectance at the first wavelength;

and

a second reflective optical element comprising a second multilayer system with a maximum of reflectance at the second wavelength,

wherein the first and second reflective optical elements are preferably interchangeable with an operating reticle used for operating the apparatus during exposure.

85. (Withdrawn) The apparatus of claim 84, wherein the first wavelength and/or the second wavelength is determined by the given thickness of the layers of the first multilayer system and/or the second multilayer system, respectively.

86. (Withdrawn) The apparatus of claim 82, further comprising means for adjusting a residual gas atmosphere inside the apparatus.

87. (Withdrawn) The apparatus of claim 82, further comprising a cleaning reticle.

88. (Withdrawn) The apparatus of claim 82, further comprising a collimator and/or at least one aperture for geometric beam shaping.

89. (Withdrawn) The apparatus of claim 82, further comprising means for generating local differences of partial pressures.

90. (Withdrawn) The apparatus of claim 82, further comprising a first photon detector for detection of photons at the operating wavelength and/or a second photon detector for detection of photons with lower photon energies corresponding to photon energies below about 90 eV.

91. (Withdrawn) The apparatus of claim 90, wherein the apparatus comprises the second photon detector, and the second photon detector is a thermal imaging camera.